U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 119.

Experiment Station Work,

XV.

STORING APPLES WITHOUT ICE.
COLD STORAGE ON THE FARM.
MECHANICAL COLD STORAGE FOR FRUIT.
KEEPING QUALITIES OF APPLES.
IMPROVEMENT OF BLUEBERRIES.
TRANSPLANTING MUSKMELONS.
BANANA FLOUR.
FRESH AND CANNED TOMATOES.
PURSLANE.
MUTTON SHEEP.
EFFECT OF COTTON-SEED MEAL ON THE QUALITY OF BUTTER.
GRAIN FEED OF MILCH COWS.
PROTECTION AGAINST TEXAS FEVER.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1900.

CONTENTS OF THE SERIES OF FARMERS' BULLETINS ON EXPERIMENT STATION WORK.

I. (Farmers' Bul. 56).—Good v. Poor Cows; Corn v. Wheat; Much v. Little Protein; Forage Crops for Pigs; Robertson Silage Mixture; Alfalfa; Proportion of Grain to Straw; Phosphates a Fertilizers; Harmful Effects of Muriate of Potash; Studies in Irrigation; Potato Scab; Barnyard Manure.

II. (Farmers' Bul. 65).—Common Crops for Forage; Stock Melons; Starch in Potatoes; Crimson Clover; Geese for Profit; Cross Pollination; A Germ Fertilizer; Lime as a Fertilizer; Are Ashes Economical? Mixing Fertilizers.

III. (Farmers' Bul. 69).—Flax Culture; Crimson Clover; Forcing Lettuce; Heating Greenhouses; Corn Smut; Millet Disease of Horses; Tuberculosis; Pasteurized Cream; Kitchen and Table Wastes; Use of Fertilizers.

IV. (Farmers' Bul. 73).—Pure Water; Loss of Soil Fertility; Availability of Fertilizers; Seed Selection; Jerusalem Artichokes; Kafir Corn; Thinning Fruit; Use of Low-grade Apples; Cooking Vegetables; Condimental Feeding Stuffs; Steer and Heifer Beef; Swells in Canned Vegetables

V. (Farmers' Bul. 78).—Humus in Soils; Swamp, Marsh, or Muck Soils; Rape; Velvet Bean; Sunflowers; Winter Protection of Peach Trees; Subwatering in Greenhouses; Bacterial Diseases of Plants; Grape Juice and Sweet Cider.

VI. (Farmers' Bul. 79).—Fraud in Fertilizers; Sugar-beet Industry; Seeding Grass Land; Grafting Apple Trees; Forest Fires; American Clover Seed; Mushrooms as Food; Pigs in Stubble Fields; Ensiling Potatoes; Anthrax.

VII. (Farmers' Bul. 84).—Home-mixed Fertilizers; Forcing Asparagus in the Field; Field Selection of Seed; Potatoes as Food for Man; Corn Stover as a Feeding Stuff; Feeding Value of Sugar Beets; Salt-marsh Hay; Forage Crops for Pigs; Ground Grain for Chicks; Skim Milk for Young Chickens; By-products of the Dairy; Stripper Butter; Curd Test in Cheese Making; Gape Disease of Chickens.

VIII. (Farmers' Bul. 87).—Soil Moisture; Fertility of Soils; Cover Crops for Orchards; Cultivating v. Cropping Orchards; Transplanting Trees; Fecundity of Swine; Food Value of Eggs Starch from Sweet Potatoes; The Toad as a Friend of the Farmer.

IX. (Farmers' Bul. 92).—Sugar Beets on Alkali Soils; Planting and Replanting Corn; Improvement of Sorghum; Improved Culture of Potatoes; Second-crop Potatoes for Seed; Cold v. Warm Water for Plants; Forcing Head Lettuce; The Date Palm in the United States; The Codling Moth; Jerusalem Artichokes for Pigs; Feeding Calves; Pasteurization in Butter Making; Gassy and Tainted Curds; Pure Cultures in Cheese Making.

X. (Farmers' Bul. 97).—Manure from Cows; Plants for Alkali Soils; Influence of Alkali on Plants; Feeding Value of the Corn Plant; Sows and Pigs at Farrowing Time; The Soy Bean as a Feeding Stuff; Alfalfa Hay for Hogs; Animal Matter for Poultry; Water and Animal Diseases; Construction and Cooling of Cheese-curing Rooms; Irrigation Investigations.

XI. (Farmers' Bul. 103).—Excessive Irrigation; Cross Pollination of Plums; Root Pruning of Fruit Trees; The Oxeye Daisy; Poisoning by Wild Cherry Leaves; Preserving Eggs; Gestation in Cows; The Long Clam; Silage for Horses and Hogs; Commercial Butter Cultures with Pasteurized Cream; The Stave Silo.

XII. (Farmers' Bul. 105).—Seaweed; The Tillering of Grains; Fertilizers for Garden Crops; Sweet Corn and Pole Beans Under Glass; Girdling Grapevines; Cereal Breakfast Foods; Food Value of Stone Fruits; When to Cut Alfalfa; Spontaneous Combustion of Hay; Preservation of Milk by Pressure; Cream Raising by Dilution.

XIII. (Farmers' Bul. 107).—Fertilizer Requirements of Crops; Persimmons; Forcing Rhubarb; Grinding Corn for Cows; Waste in Feeding Cornstalks; Molasses for Farm Animals; Feeding Ducks; Cost of Raising Calves; Feeding Calves with Milk of Tuberculous Cows; Killing the Germs of Tuberculosis in Milk; Ropy Milk and Cream; Dairy Salt.

XIV. (Farmers' Bul. 114).—Influence of Salt and Similar Substances on Soil Moisture; Extra-early Potatoes; Rotting of Cranberries; Chestnuts; Low-grade Paris Green; Crude Petroleum as an Insecticide; Skim Milk in Bread Making; Best Number of Hens in One Pen; Nest Box for Egg Records; Profitable and Unprofitable Cows.

EXPERIMENT STATION WORK

Editor: W. H. BEAL.

CONTENTS OF No. XV.

	Page.
Storing apples without ice	5
Cold storage on the farm	9
Mechanical cold storage for fruit	12
Keeping qualities of varieties of apples	16
Improvement of blueberries	18
Transplanting muskmelons	20
Banana flour	20
Fresh and canned tomatoes	21
Purslane	22
Establishing a flock of mutton sheep	23
Effect of cotton-seed meal on the quality of butter	24
Light versus heavy grain feeding for milch cows	25
Protecting Northern cattle against Texas fever	27
Explanation of terms	29
Terms used in discussing fertilizers	29
Terms used in discussing foods and feeding stuffs	29
Miscellaneous terms	30

ILLUSTRATIONS.

		Page.
Fig. 1.	Two Kansas apple caves	6
2.	A Vermont apple storage house	7
3.	Cross section of a Vermont apple house	7
4.	Longitudinal section of a Kansas cold-storage house	9
5.	A, Cross section of a Kansas cold-storage house. B, Details of construction of a Kansas cold-storage house	10

EXPERIMENT STATION WORK—XV.[1]

STORING APPLES WITHOUT ICE.

Perhaps the simplest way of storing apples is to put them in a pit or cellar, but, as a Kansas Station bulletin points out, this method provides only imperfectly for ventilation and a low, even temperature, which are essential conditions in keeping fruit of any kind, while, for hygienic reasons, the storing of fruit under dwelling houses is not to be recommended. A certain amount of decay is inevitable, and the decaying fruit becomes a propagating place for disease germs which permeate the rooms above, frequently causing sickness.

The Kansas Station reports a case in which apples were cheaply stored by enlarging an old hotbed and lining the bottom and sides with straw. This pit was filled with Winesaps, covered with a layer of straw a foot deep, and protected from rain by a sheet of oiled muslin spread over the top. The succeeding winter was mild and the fruit came out in the spring in good condition, but it is doubtful whether it would be safe to store apples in this way year after year in a climate as cold as that of Kansas. A modification of the pit system, shown in fig. 1, is frequently seen. Such pits or caves vary, of course, in details of construction, but the general principle is the same throughout, and the description of one will illustrate the class.

Such a cave is usually constructed on a hillside sloping toward the north, so that the entrance is protected from the southwest winds that prevail during summer and autumn. In moist soils the cave must be walled, in dry soils no walls are required. Upright posts along the sides support the top, which is made of poles; over the poles

[1]This is the fifteenth number of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

is a layer of coarse hay, and over the hay, soil to the depth of 2 feet. Several flues are made for ventilation. Such a cave may be built any desired dimensions; some are being planned with doors in each end and large enough to allow a passageway for a wagon through them. The best system of ventilation and the most even and desirable temperature can be maintained by use of an underground ventilation pipe leading from an opening in the floor of the cave to a similar opening on the surface of the ground several rods away. The pipe should be large enough to provide sufficient air for the cave and should have valves at each opening to regulate the supply. The air in passing through the pipe is cooled in summer and warmed in winter and thus brought to near the proper temperature for good results in keeping fruit. To complete the system several flues should lead through the top of the cave to the open air above. The sum of the capacities of these flues should at least be equal to the capacity of the ventilator leading into the cave.

The primitive methods of underground storage have the merit of being inexpensive and serviceable in pioneer conditions, but they are

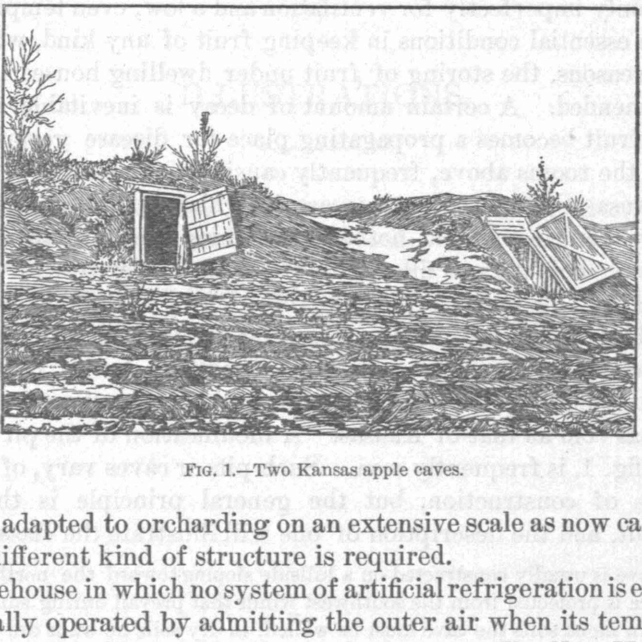

FIG. 1.—Two Kansas apple caves.

not well adapted to orcharding on an extensive scale as now carried on. Here a different kind of structure is required.

A storehouse in which no system of artificial refrigeration is employed is generally operated by admitting the outer air when its temperature is low enough, and excluding it at other times. The New Hampshire Station has recently constructed a very cheap but serviceable storage room on this principle, which is described as follows:

We commenced building a room for cold storage about the middle of December, taking three 15-foot bents on the north side of the barn cellar. We first dug a trench about a foot deep where the partition was to run. Into this trench was set the lower ends of the studding, spiking the upper ends to the floor timbers. Two by 6-inch joist were used for studding. This, with an inch on each side for sheathing, made a partition 8 inches thick. We then put down into the trench two planks, one on either side of the studding, letting the upper edge come just to the top of the ground. The top edge was leveled and then nailed to the studding. The earth was then trampled in on the outside planks. In this way we secured a good firm bottom to the partition, with no possible chance for the air to get in.

We next put in the ventilators, which are the most important things to the system. The fact that the cold-storage room was on the north of the cellar made it necessary to run the ventilator across the cellar. This was done by digging a trench deep enough to admit a plank spout 12 inches square to be covered with 6 inches of dirt.

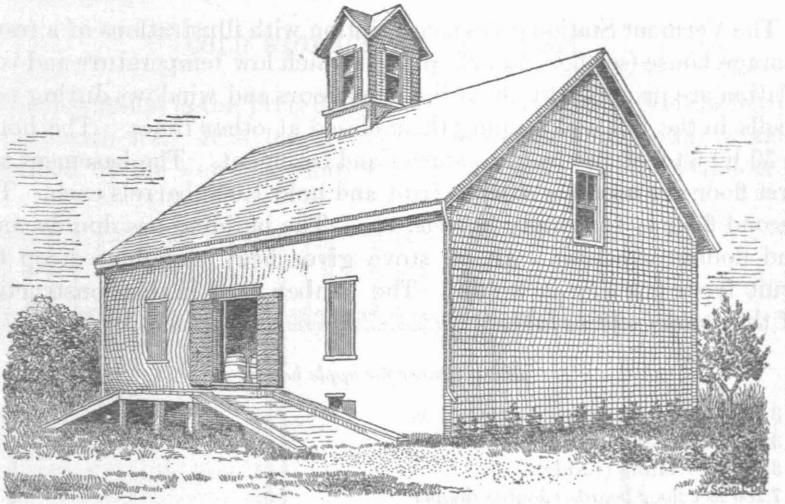

FIG. 2.—A Vermont apple storage house.

Just outside of the cellar we connected on a vertical spout, which came up about 4 feet above the top of the ground. The top of this was a trap, which will admit the air and at the same time keep out the storm. Inside the cold-storage room another vertical spout came up about 1 foot above the top of the ground, with a damper to shut off the draft when desired. Thus we had a good connection with the pure air outside. To complete the ventilation we made on the north side, about midway from each end of the house, another ventilator of the same size, but made of matched pine boards, which extended to the roof of the barn. This is also fitted with a damper, so that the room may be closed and kept entirely free from connection with the outside air.

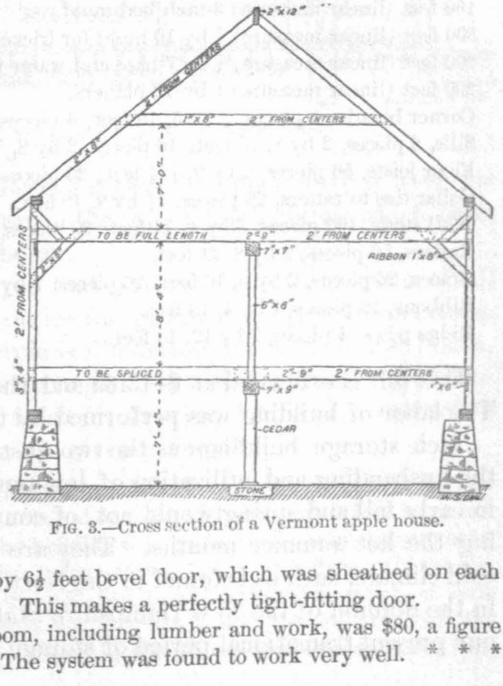

FIG. 3.—Cross section of a Vermont apple house.

The partition and ceiling are sheathed up on both sides of the timbers and the space between the sheathing filled in with fine shavings packed as hard as possible. For a door we made a 2½ by 6½ feet bevel door, which was sheathed on each side and filled with dry shavings. This makes a perfectly tight-fitting door.

The cost of the cold-storage room, including lumber and work, was $80, a figure which is within the reach of all. The system was found to work very well. * * *

About 300 barrels [of apples] were put into the cold-storage room. We examined some of the barrels from time to time and found them in excellent condition. The percentage of decay from the time of picking until March was only 6.2 per cent. * * *

The cost of keeping the apples was nothing, except the time required for packing them and the little trouble of turning the barrels and looking after the ventilators.

The Vermont Station gives a description with illustrations of a frame storage house (see figs. 2 and 3, p. 7) in which low temperature and ventilation are provided by throwing open doors and windows during cool spells in the fall and keeping them closed at other times. The house is 30 by 50 feet and has two stories and basement. The basement and first floor are used for storing fruit and hold 1,000 barrels each. The second floor is for empty barrels, etc. The building has double walls and double windows. An oil stove gives heat enough to keep the fruit from freezing in winter. The lumber used in the construction of this house was as follows:

Bill of lumber for apple house.

3,500 feet wall boarding.
3,000 feet roof boarding.
3,500 feet ceiling (inside).
7,200 feet floor boards (double floors).
4,000 feet clapboards.
25 bundles lath.
22½ squares slate.

OUTSIDE FINISH.

200 feet (linear measure) 5-inch crown mold.
190 feet (linear measure) 3-inch bed mold.
300 feet (linear measure) $\frac{7}{8}$ by 10 mold for frieze and facia.
200 feet (linear measure) $\frac{7}{8}$ by 7 base and water tables.
200 feet (linear measure) $\frac{7}{8}$ by 12 planers.
Corner boards, 4 pieces, $\frac{7}{8}$ by 5, 15 feet; 4 pieces, $\frac{7}{8}$ by 6, 15 feet.
Sills, 8 pieces, 2 by 8, 15 feet; 16 pieces, 2 by 8, 13 feet.
Floor joists, 56 pieces, 2 by 9, 15½ feet; 26 pieces, 2 by 9, 30 feet.
Collar ties to rafters, 26 pieces, 1½ by 9, 19 feet.
Wall studs, 100 pieces, 3 by 4, 14 feet; 20 pieces, 3 by 4, 12 feet.
Rafters, 56 pieces, 2 by 8, 21 feet.
Braces, 26 pieces, 2 by 6, 10 feet; 26 pieces, 1 by 6, 8 feet.
Ribbons, 16 pieces, 1 by 4, 13 feet.
Ridge poles, 4 pieces, 2 by 12, 13 feet.

This bill is estimated at $443.69 and the house cost $1,500 finished. The labor of building was performed by the owner at spare times.

Such storage buildings as the two just described, which depend on the husbanding and utilization of low temperature during cold waves in early fall and spring would not, of course, fulfill their purpose during the hot summer months. They are obviously best adapted to a cold climate, such as is found in the Northern States. Here they can, in the opinion of the New Hampshire Station, be made more useful in our present transitional period of storage construction than any other.

Their defect is that they do not maintain a sufficiently low and even temperature, and they would be of little use in a warm climate. How this defect may, in part at least, be overcome, will be shown in the next article.—V. A. CLARK.

COLD STORAGE ON THE FARM.

The discussion in the preceding article leads up to the desirability of storage with ice. It is but a step from such a fruit house as that described by the Vermont Station to ice storage. Aside from details

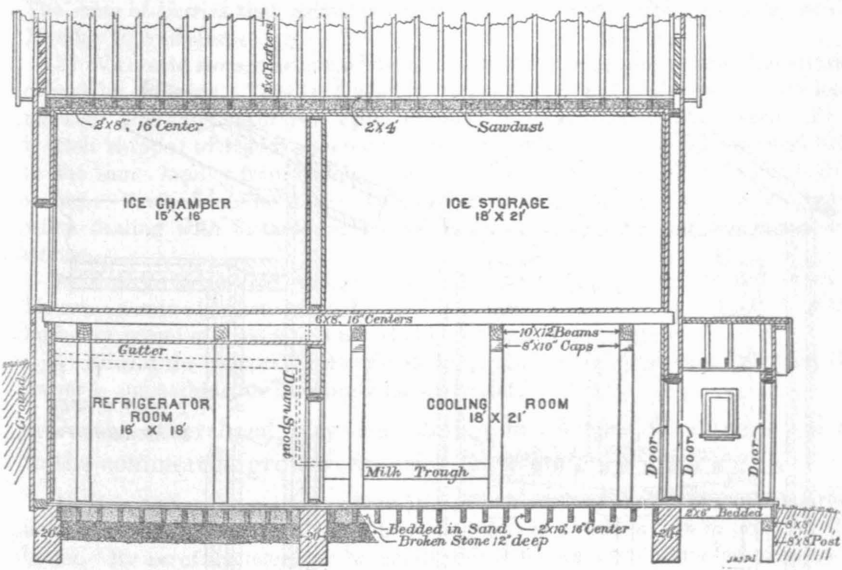

FIG. 4.—Longitudinal section of a Kansas cold-storage house.

of construction the only difference is that the upper story is used for storing ice, thus cooling the air in the top of the building which sinks and in turn cools the rooms below.

This is the general principle that governs the construction of all storage houses that depend on ice for producing a low temperature. The application of this principle is illustrated in a cold-storage house, description and plans of which are given in a Kansas Station bulletin. Drawings of the house (figs. 4 and 5), showing details of construction and a part of the description, are given herewith:

The building is designed to be located in a hillside of such a slope that the first floor will be on the level of the surface at one end and the second floor a few feet above the surface at the other. The building is 18 by 38 feet, interior measurement, two stories in height and divided into four rooms, two on each floor. On the second floor is the ice-storage room, 18 by 21 feet, in which the future supply of ice is stored, and the ice chamber, 15 by 16 feet, in which is held the ice that cools the refrigerating room directly below. A door in the ice chamber communicates with

the outside. This is for the unloading of ice and is the only outside entrance into the second story. The refrigerating room is 16 by 18 feet, and is the compartment in which the temperature is to be reduced, and in which perishable products are to be stored. Leading into this room is the cooling room, 18 by 21 feet, which is to be used as a general purpose storage cellar. A small entrance room protects the doorway into the cooling room. This is the only entrance to the ground floor. * * * The flooring is laid tight in the storage room and provided with a slope toward the center. A gutter catches the drainage and carries it into the gutter from the ice chamber. To prevent leakage the floor of the storage room must have a sheet-iron covering. The floor of the ice chamber is laid with 2 by 4-inch lumber with 1-inch

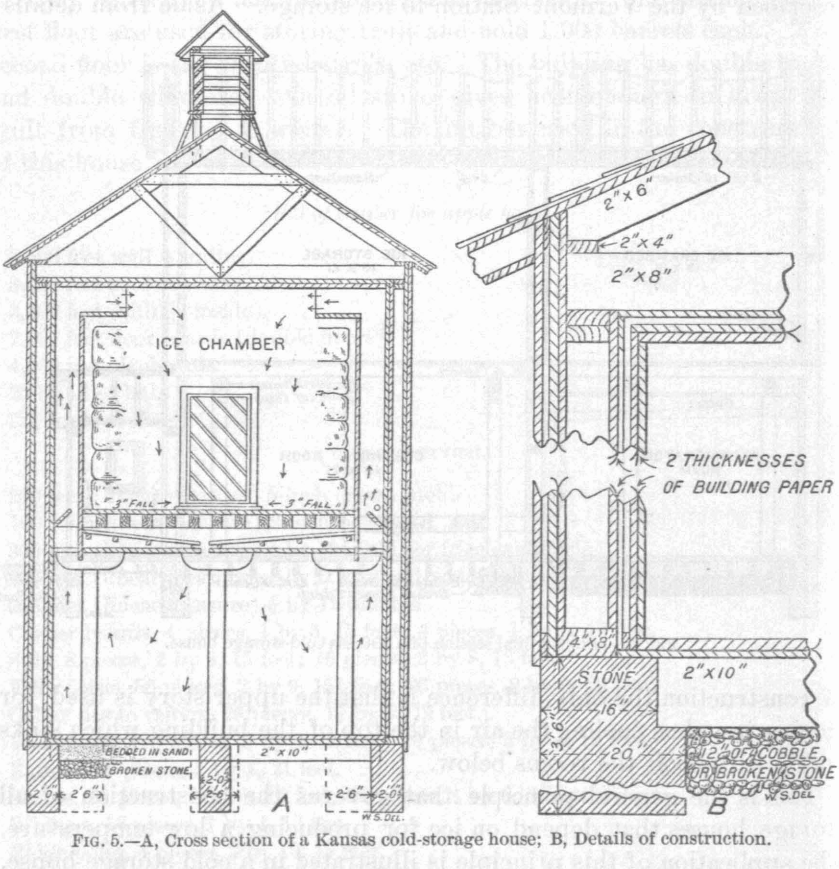

FIG. 5.—A, Cross section of a Kansas cold-storage house; B, Details of construction.

spaces between. This provides for air circulation and water drainage. A sloping catch floor leads the water into the gutter which carries it down and out through the cooling room.

Such a house is large enough for the requirements of an ordinary fruit farm, but the plan will work successfully with either larger or smaller dimensions.

The West Virginia Station describes a cold-storage house in connection with which there is an arrangement for storing ice with little expense. The house is built on sloping ground. In the rear is a pond

almost on a level with the top floor. This pond is supplied from a small stream and from it the ice is drawn directly into the fruit house.

Home cold storage has great advantages, not merely over storage without ice, but even in certain respects over city cold storage. These advantages are thus contrasted by the Kansas Station:

(1) The ice and cold storage house at the home provides a means of keeping products that are of daily demand in the home and on the local market; also those products that are quickly perishable but not of sufficient importance to be sent to the city warehouse. Butter, milk, eggs, poultry, and fresh meats of all kinds can be kept in summer without deterioration; while the summer fruits that decay rapidly under ordinary conditions can be kept in cold storage and used or sold at pleasure. The crate of berries that Saturday night finds undisposed of will not decay before Monday in cold storage.

(2) With cold storage at home fruit can be stored quickly and without the injuries caused by shipping. This is of especial importance if it is to be sold on the local market. The shipping of fruit injures it unless the most extreme care is taken. Fruit is often shipped to distant warehouses and, after the storage season, is shipped back to the same locality from which it came. This would be avoided by home cold storage. Fruit should be stored as soon as taken from the tree. This is impossible when dealing with distant warehouses, but possible where we have home cold storage.

(3) Fruit in home cold storage can have the constant personal care of the owner. He can examine it when he wishes and sort when necessary; he can sell it by the bushel or barrel in a week or a month and pay no extra storage fee.

(4) Should the commodity deteriorate in quality, or the price fail to advance, the owner is out nothing for transportation and little for storage.

On the other hand, city cold storage has several advantages which, to the commercial grower, are very important:

(1) It is nearer the market, where [the fruit] can be disposed of on the shortest notice. This enables the holder to take advantage of a sudden turn in price for the better. By use of the telegraph he can dispose of his whole crop in a few minutes.

(2) By storing in city warehouses fruit does not usually have to be shipped after it has been in storage. Shipping after storage is an injurious process and should be avoided, but if it must be done the facilities for loading in the large warehouses are such that the fruit need not undergo change of temperature or injury. Adjoining the storage rooms are loading sheds which are kept very cool. The refrigerator cars in which the fruit is to be shipped are run into the sheds and the fruit is taken from the storage room directly into the cars, which are already cooled to a low temperature.

(3) Fruit in city warehouses is practically on exhibition all the time, and if it is of superior quality it is a standing advertisement for the owner. Buyers find out to whom to look for such fruit. Commercial reputation and standing is no small thing in these pushing times. A man must not only grow fruit of first quality, he must make it known that he grows it. He will profit by storing it where buyers can find it.

The following table shows the temperatures recommended by the Kansas Station for preserving some of the most common horticultural products, and indicates the packages in which they should be stored and the time they may be expected to keep:

Temperature for preserving different products.

Product.	Temperature.	Package.	Time.
	° *F.*		
Apples, summer	38 to 42	Barrels or boxes	2 to 4 months.
Apples, winter	32 to 35	.....do	5 to 8 months.
Pears	33 to 38	.....do	2 to 4 months.
Peaches	36 to 38	Crates	2 to 4 weeks.
Grapes	38 to 40	In sawdust in boxes	6 to 8 weeks.
Plums	38 to 40	Crates	2 to 4 weeks.
Berries and cherries	40	Quart boxes	1 to 3 weeks.
Bananas	40	Crates	8 to 12 weeks.
Lemons, oranges	40	.....do	8 to 12 weeks.
Figs, raisins	40	Boxes	8 to 12 weeks.
Watermelons	40		3 to 6 weeks.
Muskmelons	40		2 to 3 weeks.
Tomatoes	38 to 42	Crates	2 to 4 weeks.
Cucumbers	38 to 40	.....do	1 to 3 weeks.
Celery	35	Boxes	
Cranberries	34 to 38	Barrels	
Onions	34 to 40	.....do	
Potatoes	36 to 40	.....do	
Asparagus, cabbage	34	Boxes	

—V. A. CLARK.

MECHANICAL COLD STORAGE FOR FRUIT.

Mechanical cold storage is not considered practicable on the ordinary farm because of the expensive machinery required. It is better adapted to large than to small establishments.

Many fruit growers have made tests of it as a practical means for preserving fruit, but with widely varying results. The Kansas Station instituted a series of experiments on the subject which were designed to determine or at least throw more light on the questions of what kinds of fruit can be stored with safety, the best methods of handling fruit designed for storage, the best packages and methods for shipping, the length of time fruit will keep in storage, the proper temperature for keeping the different sorts of fruit, and the management of fruit while in cold storage.

With peaches the results of the tests indicated that this fruit is not well adapted to cold storage; in fact, is not at all available for the purpose unless handled very carefully. With such handling it may be kept from two to four weeks. Present methods of packing are far too crude for the exacting requirements of cold storage. The Kansas Station declares that "95 per cent of the peaches that come to market are roughly handled, and unsafe to put in storage even for a few days." A number of methods of packing were tested. The package that gave best results was an ordinary egg case. Holes were cut in the sides of the box and in the pasteboard sheets that separate the layers to allow

the passage of air. Over the fruit was placed an inch layer of excelsior and the lid was nailed on. Peaches packed in this way kept from five to seven days longer than when packed in any other.

Grapes in sawdust gave better results than those in baskets or open trays.

The berries seemed to hold to the stem better than in either of the other cases. They were also slower to show mildew, owing to the fact that the sawdust absorbed the moisture that evaporated from the grapes and kept them dry. A difficulty with sawdust packing is that it adheres to the fruit and stem so that in shaking it off the berries are detached. Cut cork was suggested as better packing material than sawdust. Next after packing in sawdust the method of storing in trays gave best results, as it kept the fruit drier than the baskets.

Dryness is essential to the successful preservation of grapes. Moisture causes the growth of mold, which at once ruins the fruit. With the present moist storage rooms some good absorbent such as sawdust must protect the fruit. Better success with grapes would be attained in a room cooled by dry, cold air currents than by the present systems of refrigeration. Such storage rooms are already being planned in some warehouses. * * *

Grapes held up in good condition from six to eight weeks. The results of other seasons agree in fixing this as the limit for grapes grown in our section. The length of time varies considerably with the different varieties. Delaware, Agawam, Brighton, Duchess, Centennial, Concord, Worden, and Hays, ranking in the order named, have kept the best. It is noticeable that the red grapes head the list, the first three being red. The fourth and fifth of the list are white, while the black grapes represented by Concord and Worden rank in the sixth and seventh places. The varieties that kept best are those that rank as early grapes. However, no extremely late varieties were tried. Had they been tried the results might be different. The climate in which the grapes grow modifies their keeping qualities. A grape maturing slowly in a climate of moderately cool, regular temperature will keep longer than one whose ripening is hastened by excessive heat.

Plums differ much in their behavior in cold storage. Robinson and Weaver, very juicy varieties, were kept from three to four weeks. With such varieties decay proceeds very rapidly when once it has begun. Less watery sorts, as Golden Beauty and Moreman, were kept in the station cooling room, which had an irregular temperature averaging about 50° F. for more than a month. Weizerka, a meaty, prune-like variety, kept for a still longer time.

Tomatoes, picked when just beginning to redden, wrapped separately in tissue paper and placed in a crate packed on the bottom and top with excelsior, were kept about two months. Green tomatoes may be held in storage for several months, but when removed instead of ripening, they simply rot.

Tests were made with cucumbers, but, contrary to expectation, they did not keep well. "With our present knowledge," says the Kansas Station, "we can not regard the cucumber as a success in cold storage."

In recent experiments in England, according to the Journal of the Board of Agriculture, the storage chambers were fitted with tiers of galvanized wire shelves around the sides and the fruit was placed on

these under three different conditions: (1) Exposed on the shelves; (2) enveloped in grease-proof paper; and (3) surrounded or covered by cotton wool.

It was found that strawberries could be kept for at least three weeks in a temperature of 30°, but it was necessary to surround the fruit with cotton wool, or, in the case of fruit, in sieves, to place a pad of that material over the top. When this precaution was not taken, the fruit, though sound, became dull and lost the fresh inviting appearance which is so important when it is offered for sale. Black currants kept well for ten days, after which they began to shrivel, but plumped and freshened on exposure to the air so as to be marketable. This was especially the case with black currants that had been stored in market sieves covered with a wad of cotton wool. After a fortnight's storage, the temperature was raised from 30° to 32° F., and this seemed to give the best results. The experiments with red currants were an unqualified success, the fruit remaining perfectly sound for six weeks, and maintaining its freshness when exposed to a normal temperature for sixteen hours. Cherries covered with wool kept for a month at a temperature of 30°, and at 36° were not only sound, sweet, and juicy, but fresh and clear. After the fourth week the fruit began to wrinkle. * * *
Green gages were kept in excellent condition for ten weeks and Victoria plums kept for nine weeks, but the cooking varieties of plums, with that exception, did not lend themselves satisfactory to cold storage.

We have thus far discussed only summer fruits, that is, fruits that ripen in summer and keep but a relatively short time after ripening. On account of their perishable nature, the application of cold storage to their preservation is with quite different purpose than is the case with winter apples, potatoes, etc. Its value is not in keeping them from one season to another, or from early to late in the same season, for it can do neither. It is of use only in holding them over short periods of stagnation and gluts in the market. A week's time, and frequently only a few days, is sufficient for this.

In order to be successful in storing summer fruits, the requisite conditions of ventilation and temperature must be carefully observed. Air should be freely admitted to every part of the package. Cooling should be gradual, and should be done before shipping, if possible. When once cooled the temperature should never be allowed to rise again or permitted to vary. For maintaining a low and even temperature during transportation, refrigerator cars are indispensable. They should be iced and closed several hours before loading in order to have them at the proper temperature. The car also should be air-tight except the parts that provide for ventilation.

Experiments were also made by the Kansas Station with winter fruit. Pears were kept from three to four months. They should be packed in bushel boxes, each specimen being wrapped separately if the quality will warrant it. The most favorable temperature for fall varieties as shown in the tests is 36° to 38° F., while winter varieties require a temperature of 33° to 35°. Winter Nelis from Kansas did not keep as long as the same variety from California, indicating that climate has a stronger influence on the keeping qualities of fruits than

the distance they are shipped, provided proper attention is paid to packing.

Apples for cold storage should be sorted and packed with great care and shipped without delay to the storage house. If the fruit is to be long on the road, refrigerator cars should be used. The Kansas Station experiments were with Ben Davis, Winesap, Missouri *Pippin*, Rambo, and Ralls *Genet*. They were packed in October and later examined, with results as follows:

December 9, in good condition. January 23, most in good condition, a few decaying specimens among Winesaps, Missouri Pippins, and Rambos. February 23, Jonathan and Missouri *Pippin* mellowing, will not keep safely a great while longer. Rambo in good condition. York Imperial, Ben Davis, Winesap, Ralls *Genet* still in fine condition. These four varieties will doubtless hold to the end of the season if they are sorted and repacked. The temperature of the storage room has been 33°.

The Canada Experimental Farms made experiments to ascertain the best methods of storing apples in winter. The experiments began in autumn and the final examination of the fruit was made July 29 following.

Specimens wrapped in paper kept better than those not wrapped, there were few rotten apples, and they lost least by evaporation. The ground-floor storeroom did not preserve them as well as the cellar. * * * A tight package preserved the fruit best in storeroom, but not in cellar; per contra a ventilated package did better in cellar than in storeroom.

A striking example of the possibilities of cold storage in the preservation of apples is furnished by the work of the Nebraska State Horticultural Society at the Trans-Mississippi Exposition of 1898. The fruit was gathered and put in cold storage during the fall of 1897, most of it during the month of October, though some not until December. Each apple was wrapped first in a sheet of waxed paper, using 9 by 12 inch sheets for small apples and 12 by 12 inch sheets for large ones. Then another covering of common newspaper was added. This double wrapping made practically an air-tight cell for each apple, thus preventing any spread of decay. The fruit was then carefully packed in barrels, filling them up so as to require considerable pressure to get the heads in. The temperature of the room in which they were stored did not vary over one degree from 36° from the time they were placed in it until they were removed. A number of varieties were still in good condition November 1 of the following year.

To determine how such double wrapping lengthens the period of keeping, a few barrels of unwrapped Ben Davis and Winesap apples were placed in the same storage room at the same time and received exactly the same treatment as the others. Seventy per cent of them were decayed when taken out June 1. Those remaining in firm condition were so badly discolored and had lost flavor to such an extent as to render them wholly unfit for either show or market. A few of the same varieties were also wrapped in newspaper only. Of these about 30 per cent were in very poor condition June 1.—V. A. CLARK.

KEEPING QUALITIES OF VARIETIES OF APPLES.

It is a matter of common knowledge that varieties of apples, as of other fruits, differ greatly in their keeping qualities. Not all varieties are adapted to the same conditions. In general, a juicy fruit or one that matures early in the season, does not keep as well as a drier, firmer fruit, or one that matures later.

The Canada Experimental Farms made a test of the relative keeping quality of 23 varieties of apples as stored in a cellar. The temperature ranged from 35° to 40° F. for three months, with the exception of one very cold snap, when it fell to 26°. The apples were undoubtedly frozen, but were in the dark and thawed out gradually. April 15, the thermometer rose to 45° F., and in May a little higher. The fruit was not ripe. It was examined May 28, with the following results:

Relative keeping qualities of twenty-three varieties of apples.

Variety.	Sound.	Partly decayed.	Rotten.	Variety.	Sound.	Partly decayed.	Rotten.
	Per ct.	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*
Ben Davis	100			Swayzie Pomme Grise	31	6	63
Newell	93	7		Pewaukee	20	47	33
Wagener	88		12	Watterson No. 3	20	40	40
Ralls *Genet*	82	6	12	Salome	20	40	40
Winesap	82	4	14	Fameuse	12	18	70
Walbridge	73	13	13	Quaker Beauty	4		96
Green Sweet	72	11	16	Hardisty		25	75
Crimean	62	15	23	Haas			100
Lawver	49	11	40	Gideon			100
Bombarger	44	36	20	McIntosh			100
Duke of Connaught	42	16	42	Anisovka			100
Hardy	34	33	33				

In another experiment at the same station the following varieties kept until February: Louise, McMahon, Longfield, Wealthy, Gideon, Fameuse, Haas, Newell, and McIntosh. The following kept until March: Watterson No. 3, Ontario, Flushing *Spitzenberg*, Golden Stone, Pewaukee, and Plumb Cider. The following kept until April or later: Walbridge, Salome, Ralls *Genet*, Jewett *Red*, Lawver, Sharp Russet, Hartshorn, Swayzie Pomme Grise, Scott Winter, Ben Davis, and Thompson 35.

The relative keeping quality of varieties under cold-storage conditions was tested by the Nebraska Horticultural Society. The report of these experiments, referred to in the preceding article (p. 15), is valuable not only as demonstrating the length of time fruit may be kept under favorable conditions, but also for its observations on the relative merits of varieties in this respect, and for the light which it throws on the manner of their final deterioration. The fruit, which went into storage in the fall of 1897, was taken out at intervals during the summer and fall of 1898, and at that time was examined and each variety received a mark according to the condition in which it was found. Those in perfect condition, or as nearly so as apples could

be at that time of the year, were marked 10, and those that in any respect showed deterioration were scored accordingly. The following table shows the varieties tested and their relative keeping qualities in this test:

Relative keeping quality (on a scale of 10) of varieties of winter apples.

Variety.	June 15.	July 14.	August 2.	September 2.	October 2.	November 1.
Ben Davis	10	10	10	10	10	10
Winesap	10	10	10	10	10	10
Ralls *Genet*	10	10	10	10	10	10
White Pearmain	10	7	6	6	4	3
Limbertwig	10	10	10	10	10	10
Allen Choice	10	10	10	10	9	8
Willow *Twig*	10	10	10	10	10	10
Sweet Russet	1C	10	9	9	8	8
Gilpin	10	10	10	10	10	10
Lansingburg	10	10	10	10	10	10
Jonathan	7	8	8	8	7	6
Grimes *Pippin*	7	8	8	7	6	5
Missouri *Pippin*	8	7	6	5	4	2
Northern Spy	....	7	6	5	3	0
Iowa Blush	8	8	8	8	7	5
McIntosh	9	9	9	9	9	9
Walbridge	5	3	2	1	0	0
Yellow Bellflower	6	0	0	0	0	0
Eicke	8	8	8	8	8	7
Price Sweet	....	7	7	6	0	4
Sheriff	8	3	0	0	3	0
Fulton	7	5	4	3	8	0
Rome Beauty	8	8	8	7	6	5
Salome	9	9	9	9	9	3
Minkler	8	7	7	6	5	4
Domine	9	8	8	8	7	6
English Russet	....	6	5	4	4	0
Roman Stem	8	7	6	5	4	0
Ortley	7	....	6	4	3	0
Milam	7	....	7	7	6	6
Tolman *Sweet*	6	....	5	4	2	0
Perry Russet	6	....	....	....	....	....
Wagener	5	....	4	2	0	....
Fameuse	7	....	5	3	0	....

One of the most interesting parts of the report is the account of the behavior of the different varieties in cold storage. Some retained all their good qualities up to the close of the exposition, November 1, 1898. These were Ben Davis, Winesap, Ralls *Genet*, Limbertwig, Willow *Twig*, Gilpin, and Lansingburg. Although the Salome lost a little in quality, it kept well in storage and on the table. Fruit taken from storage June 1 retained color and firmness for nearly five weeks. Some retained a good outward appearance but lost in some other quality, as, for instance, the Iowa Blush, the skin of which became so bitter as to render the fruit unfit for use. On the other hand, some varieties retained their eating qualities, but lost in outward appearance. Such was the Milam, which kept well but lost in color. There were also numerous other kinds of deterioration: Minkler lost flavor and began to decay; the English Golden Russet and Fulton shriveled; the Roman Stem became mealy and lost flavor; Sheriff and Walbridge discolored so badly as to render them unfit for show or market and they deteriorated rapidly; Fameuse, retained color but many bursted and after a few days became mealy; the Yellow Bellflower went down suddenly.

Moreover the behavior of varieties having a certain characteristic in common was not always the same in respect to it. The Missouri *Pippin*, a dark apple, faded in storage, but the Walbridge and Sheriff, also dark apples, came out almost black; nor did the lighter colored apples fade more than the dark red ones, for Grimes *Golden* and Yellow Bellflower, both yellow apples, held their color unchanged while Missouri Pippin, a dark red apple, as has been said, faded.—V. A. CLARK.

IMPROVEMENT OF BLUEBERRIES.

An investigation of this subject has been undertaken by the Maine Station. In a report of that station it is stated that blueberries are found growing in great quantities in many of the Eastern and Northern States on soils which are, as a rule, of little or no value for general agricultural purposes, but that while the berries have been highly prized as an article of food from the earliest colonial period, "practically no attention has been given to the cultivation and systematic improvement of the fruit." Plants have from time to time been introduced into gardens with good results, and the management of blueberry barrens has occasionally been undertaken. An account of an experiment of the latter kind is reported by the Maine Station. The blueberry lands described consist of 40,000 acres belonging to one owner.

The land is divided into several parts, each of which is leased to some responsible party who assumes the whole care of burning over the land, keeping off trespassers, harvesting, and marketing the fruit. * * * Every year a certain section of each "lease" is burned over. This burning must be done very early in the spring before the ground becomes dry; otherwise the fire goes too deep and humus is burned from the ground and most of the bushes are killed. Many hundred acres of what would be the best part of the barrens have thus been ruined. The method most commonly used in burning a given area is for the operator to pass around the section to be burned, and drag after him an ordinary torch or a mill lamp. He then retraces his steps over the burned area, setting after-fires in the portions which have escaped, and back-firing if there is danger of spreading unduly over areas which it is desired to leave unburned. A device which was found in use by one party consists of a piece of half-inch gas pipe bent at the end at an angle of about 60°. The end opposite the bent portion is closed with a cap or plug, and in the other end, after filling the pipe with kerosene, is placed a plug of cotton waste or tow. This device is regarded as superior to the lamp or torch as it is more easily handled.

Systematically treated blueberry fields are burned over about once every three years. This burning renews the bushes and tends to check the growth of underbrush.

The early ripening fruits on these lands are picked by hand and sent to the city markets, usually in quart boxes. Later in the season the fruit is sent to the canneries. On the older barrens, especially on areas which are to be burned over the following spring, the fruit is gathered with a "blueberry rake."

This is an implement somewhat similar to the cranberry rake in use on Cape Cod, and may be likened to a dust pan the bottom of which is composed of stiff parallel

wire rods. The fruit may be gathered much more quickly and more cheaply by means of the rake. The bushes are, however, seriously injured by the treatment. In no case should the rake be employed in gathering the high-bush blueberries.

Experiments are under way at the Maine Station for the improvement of blueberries. Promising bushes of different species have been planted out and seed from some of the largest and best fruits from desirable bushes sown. The great variation in the size of the bushes, habits of growth, and quality of the fruits in the natural state, favor the belief that the propagation of superior fruits through selection is quite possible.

At the New York State Station considerable difficulty was met with in growing seedling plants of the high-bush huckleberry (*Vaccinium corymbosum*) because of the delicate nature of the young plants and the very careful treatment which they require. The same station made an examination of the flowers of this species in order to learn at what time the stamens yield their pollen.

This seems to be given off immediately before and for a short time after the corolla opens. By opening the corolla of flowers about to expand and jarring the blossoms vigorously over a glass slide, we secured pollen in considerable quantities, which is an indication that the flowers may be at least in part self-fertilized. Nothing appeared in the structure of the flowers to render artificial crossing difficult.

The experience of one grower in Massachusetts leads him to the following conclusions:

(1) It [the high-bush blueberry] does not take kindly to garden cultivation; (2) it is very difficult to propagate from the seed; (3) it is somewhat difficult to graft, but patience and a little of the "know how" will overcome all of these. If grown in the garden, (1) they must be on the north side of a board fence or in the shade of trees and the ground must be mulched with leaves or evergreen boughs; (2) let the seed get fully ripe and drop, then sow in a shady place; (3) graft small bushes at the surface of the ground and cover most of the scion with moist earth.

Success in growing blueberries has been attained by all of these methods.

Another grower reports that he has been very successful in growing high-bush blueberries on a poor, rocky, upland soil. The bushes improved much in thrift and yielded from three to four times as much fruit as wild bushes growing in pastures and swamps and the berries were from 25 to 30 per cent larger. He advises setting plants 6 feet apart each way and mulching with strawy manure in the fall.

The results of the experiments thus far conducted would seem to show that the blueberry is subject to much variation and is greatly improved by cultivation. Blueberries are as yet but little cultivated, but the few attempts that have been made toward their improvement indicate that with care satisfactory results may be obtained. Meanwhile natural blueberry barrens may be made to give increased yields by systematic burning and care, and thus these lands, otherwise worthless for agriculture, made sources of profit.—C. B. SMITH.

TRANSPLANTING MUSKMELONS.

Experiments in transplanting muskmelons for the purpose of securing extra earliness or increased yields have been conducted at several of the experiment stations. At the New Hampshire Station transplanted plants obtained by starting seed in thumb pots, transplanting to 4-inch pots, and hardening off in a cold frame, were set in the field June 1 alongside of hills of the same varieties planted from seed on the same date. The largest total yield of each of the three varieties tested was obtained from the vines grown from seed planted in hills. The transplanted vines ripened their fruit earlier than the vines grown from hill-planted seed. The number of ripe melons obtained at different dates of picking up to September 5, after which the field-seeded melons outyielded the transplanted vines, are shown in the following table:

Yield of transplanted and hill-sown muskmelons up to September 5.

	August 23.	September 1.	September 2.	September 5.	Total.	Gain.
Transplanted	2	7	27	27	63	36
Field seeded			8	19	27	

Whether this extra early yield will pay for the extra labor can be determined only by the conditions and facilities of the grower. Generally speaking, it is doubtless a questionable undertaking, but in a few instances might be profitable. The experiment in point of earliness shows but comparatively few fruits and but ten days in the extreme, and but a few days in the majority of cases, in favor of the transplanted plants.

At the Colorado Station "a test was made to note to what extent hot-bed propagation may hasten maturity and how successfully it may be performed."

The seed was put in hotbeds April 3. Some seed was put in cans so arranged that the plants could be taken from them without disturbing the roots. Other seed was put in the hotbed without any support. It was found quite difficult to transplant them when the roots were at all disturbed. Fully 95 per cent of those set out from the cans grew, and about 50 per cent of those taken from the bed without support.

The first planting in the field was on April 29, and the next on May 10. The first ripe melon was taken from the transplanted vines August 17, only one day ahead of the plants grown on alfalfa and manure, and only four days ahead of those grown with no fertilizer. They ripened in quantity, however, faster, and for the next ten days gave more ripe melons than any other planting.

—C. B. SMITH.

BANANA FLOUR.

During the past two or three years many popular statements have appeared concerning banana flour or meal. Little reliable information, however, has apparently been available on this subject. Banana flour is prepared by cutting the fruit into suitable pieces, drying, and grinding. Several years ago the Royal Gardens, Kew (England), published a somewhat extended discussion of the food value of bananas and

banana flour and stated that the latter article, according to the testimony of travelers, had been prepared by native inhabitants of tropical countries since early times. The Connecticut State Station recently published analyses of banana flour made from three sorts of bananas. In the following table the composition of these samples is shown. For purposes of comparison, the composition of fresh bananas, wheat flour, rice, and fresh and dried apples is also included.

Composition of banana flour and other foods.

	Water.	Protein.	Fat.	Carbohydrates.	Fiber.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Banana flour:						
From Porto Rico fruit	13.43	3.50	0.47	79.82	0.54	2.24
From Florida fruit	5.34	2.81	.66	87.45	.84	2.90
From Honduras fruit	10.33	2.87	.50	87.02	.73	2.55
Bananas, fresh, edible portion	75.30	1.30	.60	21.00	1.00	.80
Apples, fresh, edible portion	84.60	.40	.50	13.00	1.20	.30
Apples, dried	28.10	1.60	2.20	66.10	....	2.00
Wheat flour, patent roller process	11.50	11.40	1.00	75.40	.20	.50
Rice	12.30	8.00	.30	78.80	.20	.40

Dried ground bananas are seen to contain in the same bulk more nutritive material than the fresh. This would naturally be the case, since a large part of the water in them was removed in drying. Fresh bananas and apples are somewhat similar in chemical composition and the same is true of the dried products. The dried apples contain somewhat more water and hence less nutritive material than the dried and ground bananas. Banana flour contains much less protein than wheat flour.

As pointed out by the Connecticut State Station, the three samples of banana flour analyzed are quite alike in composition. They contain less than half as much protein as rice. Their nutritive value rests almost wholly in the materials which constitute nitrogen-free extract. In those countries where banana flour is prepared in considerable quantity, it is used in combination with milk, sugar, etc., in the preparation of custards, cakes, and similar articles.—C. F. LANGWORTHY.

FRESH AND CANNED TOMATOES.

The Minnesota Station has recently studied the composition of tomatoes and the loss of material when tomatoes are canned in different ways. The composition of three varieties of tomatoes analyzed by this station is shown in the following table:

Composition of three varieties of tomatoes.

	Acme.	Livingston.	Dwarf Aristocrat.
	Per cent.	*Per cent.*	*Per cent.*
Water	93.61	93.76	93.93
Protein	.50	.50	.44
Fat	.05	....	....
Sugars	3.85	3.86	3.79
Acid (malic)	.37	.47	.41
Ash	.69	.56	.54

As will be seen by the table, the tomato contains a large amount of water, the principal nutrient being sugars of different sorts.

When tomatoes are canned, it is a common practice to drain off the juice. The analyses of the Minnesota Station showed that this entailed a loss of about 22 per cent of the total sugar present. If it is desired to retain all the nutritive material which the tomato contains, it is evident that the juice should be retained. The product may be made more concentrated by evaporation if this seems desirable. Tomatoes canned in the form of a thick paste are sometimes found on sale. They are commonly canned in this way in Italy and are useful in the preparation of numerous dishes, such as macaroni and tomatoes, etc.

Containing as it does, over 90 per cent of water, the tomato can not be regarded as a specially nutritious food. It is believed, however, to have a useful place in the diet. Its peculiar flavor is relished by most persons, and this and its attractive appearance are sufficient to account for the estimation in which it is held.—C. F. LANGWORTHY.

PURSLANE.

Purslane (*Portulaca olearacea*), or, as it is frequently called, pusley, is commonly regarded in this country as a troublesome weed and of no value except as an occasional food for pigs. It is not generally known that it has considerable value as a food, and that it has long been used as a salad and pot herb in Europe and to some extent in this country.[1] Inquiries as to its food value have led some experiment stations to make chemical analyses of the plant. According to the Indiana Station, green purslane has the following composition: Water, 86.56 per cent; protein, 1.81 per cent; fat, 0.5 per cent; nitrogen-free extract, 6.49 per cent; crude fiber, 2.12 per cent, and ash, 2.23 per cent. According to average figures corn fodder contains: Water, 79.3 per cent; protein, 1.8 per cent; fat, 0.5 per cent; nitrogen-free extract, 12.2 per cent; crude fiber, 5.0 per cent, and ash, 1.2 per cent. Of the value of purslane as a feeding stuff, the Indiana Station says:

> Purslane compares favorably with average samples of corn fodder, so far as the protein and ether extract [fat] are concerned. Nitrogen-free extract is rather lower than in most green fodder, but the amount of water is considerably higher. The ash is higher than any ash that we have seen reported in green feeding stuffs. Owing to the relatively low amounts of fiber and nitrogen-free extract, the nutritive ratio is high, being about 1 to 5.5. The material has been used to some extent in this State for many years as a food for pigs and in many localities is highly esteemed. Analysis shows that it is well worth consideration as a feeding material for such animals as will eat it readily.

The same station also states that "the material has also a relatively high fertilizing value." According to the station's analyses the green plant contains 0.29 per cent of nitrogen, 0.045 per cent of phosphoric

---

[1] Its usefulness for this purpose was pointed out several years ago in a publication of this Department. (U. S. Dept. Agr., Yearbook 1895, p. 213.)

acid, and 0.85 per cent of potash. Valuing nitrogen at 14 cents per pound, phosphoric acid at 3 cents, and potash at 4 cents, a ton of the green material would be worth about $1.50 as a fertilizer; a ton of the dry material a little over $11.

The Missouri Station studied the composition of purslane and also its ability to retain moisture. Young vigorous plants free from blossoms were taken from the garden July 11 and suspended in one of the rooms of the station laboratory. In nineteen days (July 11 to 30) "the plants lost 45.74 per cent water out of a total of 91.67 which they contained. No observations were made between July 30 and September 5, when some leaves were yet green while the plants had developed blossoms and ripened an abundance of seed."

As stated above, purslane has been used for many years to a greater or less extent as a pot herb, being cooked in much the same way as spinach or beet tops. When properly prepared it has an agreeable though not pronounced flavor and may doubtless be profitably used to give variety to the diet by those who are fond of pot herbs.—C. F. LANGWORTHY.

ESTABLISHING A FLOCK OF MUTTON SHEEP.

For a number of years the Wisconsin Experiment Station has studied the possibility of the profitable raising of sheep and lambs for mutton under local conditions. Special attention has been paid to raising different crops to insure satisfactory forage and to raising lambs for the early spring market. Many of the conclusions are of more than local interest. The following is a summary of what the station considers the most necessary factors in establishing a good flock of mutton sheep:

Our chief consideration has been to secure good rams. It is a profitable policy in our experience to put as much value as possible in a ram. * * * The high-priced rams are usually those that have been winners of many prizes. But this is not the sense in which it is used here. A greater mistake can not be made than to buy a highly fitted prize winner, no matter what the price may be. They almost invariably prove infertile or incapable of service. While it is hardly possible to injure a lamb by too liberal feeding, provided exercise to an unlimited extent is given, it is none the less a demonstrated fact that highly fitted yearlings and those of more mature age are practically worthless in the breeding flock. The high-priced rams give good value when they are vigorous without having been pampered or starved, and most certainly when they show that they have the merit that attracts higher prices in the common market.

In the ewe flock attention should be directed toward selecting the ewes that are the deepest milkers, those that suckle their lambs best, and have the densest fleeces for their own protection. To secure heavy weights in the lambs and have them show the smooth appearance of coat and form which indicates thrift, the ewes must be free milkers. It matters little if a ewe is not as nicely rounded in form as she might be. If she is a good milker, she deserves the premier position in the flock. In fact the thinnest ewes at weaning time are invariably the best mothers, so that when the culling out is to be done it should be guided solely on the ewe's record as a mother, and not on points of style or smoothness. Ewes vary considerable in respect to the quality of the lambs they rear from year to year, so that it is well not to be

too hasty in discarding a ewe on one year's record when she has many better to sustain her reputation.

The feeding of the ewe lambs that are to furnish the new material for the flock should be liberal in every sense of the word. Feed them liberally on oats and see that they get the best pasturage that it is possible to secure for them, and it will be found surprising how lusty they will grow during the first nine months of their lives. More can be done by liberally feeding the ewe lambs to secure weight of both body and fleece in the flock than any other course that might be adopted. It is evident in the size and the weight of the fleece, and after the ewe lambs have been liberally fed during the first year, it is hardly possible to check their growth afterwards, as they then possess the power to do for themselves to a greater degree.

In a grade flock when the lambs are sold to the butcher uniformity counts for something. To secure this it should be an axiom for every flock master to never sell or dispose of a ram that proves to be a valuable breeder, as well as a getter of superior lambs. Such a ram should be permanently retained at the head of the flock and bred to the same ewes year after year, as long as it is possible to do so. In this way there continues to be similarity in the basis of the flock. Then, in choosing a new ram to mate with the get of the other, look for those qualities that are absent in the ewes to be bred to him. It is by balanced breeding that the greatest progress may be made. It may be accepted as a truth that every sheep has a fault, and when the ewes are uniformly faulty in any feature of fleece or form, the aim of the shepherd should be to secure a ram to correct it.

EFFECT OF COTTON-SEED MEAL ON THE QUALITY OF BUTTER.

In view of the quite prevalent opinion among dairymen in the North that not over about 2 pounds of cotton-seed meal per day should be fed to milch cows, some recent experiments reported by the Mississippi Station are at least interesting. The station herd was fed for two weeks on a ration composed of 10 pounds of cowpea-vine hay, 20 pounds of corn silage, 4 pounds of wheat bran, and 5 pounds of cotton-seed meal per head. The milk during the last two days was separated and made into butter. In the succeeding two weeks 6 pounds of whole cotton seed was substituted for the 5 pounds of cotton-seed meal, the milk during the last two days of the period being made into butter. In the two weeks following this the same ration was fed except that 6 pounds of corn-and-cob meal was substituted for the cotton seed. The butter was sent to St. Louis where it was scored. On a scale of 100 points the butter from the cotton-seed meal scored 95½ points, that from the cotton seed 96 points, and that from the corn-and-cob meal feeding 96 points.

There is such a slight difference between the scores that the quality is practically the same for the different feeds. The quality of the butter was not injured by feeding as much as 5 pounds of cotton-seed meal or 6 pounds of cotton seed. * * *

The average melting point of butter made from cows fed 5 pounds of cotton-seed meal a day, as determined by several tests made by this station, is 100.1° F., while that from cows fed corn meal and wheat bran as a grain ration is 96.8° F. The butter from the cotton-seed meal or cotton seed is therefore firmer and will stand shipment better during the summer months than will that made from cows receiving no cotton seed or meal.

It is the general experience that cotton-seed meal produces a hard butter, and in some instances a small amount of this feed is given for that specific purpose. Crude cotton-seed oil has been found to contain a quantity of so-called vegetable stearin, which is separated from the cotton oil of commerce in the process of refining. Its fatty acids have a high melting point and its general character is not unlike that of other oils which have been found to produce hard butter when fed to cows. Corn oil, on the other hand, contains practically no stearin and its fatty acids, like those of linseed oil, are liquid at a temperature considerably below the freezing point.—E. W. ALLEN.

LIGHT VERSUS HEAVY GRAIN FEEDING FOR MILCH COWS.

The rations fed by dairymen the country over show very wide differences in the amount and character of grain used. To some extent these differences may be said to be normal, depending on the prices of grains and concentrated feeding stuffs, the capacity of common cows to utilize large rations profitably, and the prices received for dairy products; but aside from these factors there are differences in practice which rest largely on the custom of the locality or a fallacious idea that economy in this respect is necessarily a feature of profitable management. Recognizing that this matter depends considerably upon local conditions, a few recent experiments at the experiment stations may be helpful in determining the most economical and profitable policy.

The New Jersey Station has been for several years conducting some very practical experiments with its dairy herd, which is managed as a commercial herd rather than an experimental one, and is used to produce milk for a milk route. In connection with these experiments the effect of so-called "good" and "poor" rations have been tried, the results being published in a recent bulletin. The good ration consisted of 4 pounds of wheat bran, 4 pounds of dried brewers' grains, and 2 pounds of linseed meal, with 5 pounds of timothy hay and 30 pounds of silage, and had a nutritive ratio of about 1 to 5.3. The poor ration consisted of 4 pounds of corn meal with 8 pounds of timothy hay and 12 pounds of cornstalks, and had a nutritive ratio of about 1 to 13.5. Rations similar in character to the poor ration are said to be quite common in many districts. In a period of thirty days 4 cows produced on the good ration 2,701.7 pounds of milk and 131.04 pounds of butter; and in a similar period on the poor ration, 2,014.2 pounds of milk and 94.32 pounds of butter. The good ration therefore gave 687.5 pounds more milk and 36.7 pounds more butter, equivalent to 34 per cent more milk and 39 per cent more butter on the ration containing the larger amount of grain. At local prices for feeding stuffs the cost of producing 100 pounds of milk and 1 pound of butter was practically the same for the two rations, but it is pointed out that 20 cows fed the good ration would produce as much milk and

butter as 30 cows fed on the poor ration. "It has been claimed that, other things being equal, a small herd well fed will prove more profitable than a large herd poorly fed, and the facts brought out by this study seem to emphasize the correctness of this claim and point to the importance of good feeding in the economical production of butter."

Experiments were also made in feeding different amounts of the grain making up the good ration. Ten, 15, and 20 pounds per head were fed to cows in full flow of milk. The indications were that while a healthy animal may consume large quantities of grain, the rate of increased yield is not in proportion to the increased amount of grain used after a certain point is passed. Rations containing more than 10 pounds of grain per day while they were profitable were less so than those containing this amount.

The Wisconsin Station has also reported an experiment made to compare 8 pounds of grain with 12 pounds, the grain mixture being composed of 2 parts of ground oats, 2 parts of ground corn, 3 parts of wheat bran, and 1 part of linseed meal. Hay and silage were fed for coarse fodder in addition to the grain. These experiments were not very conclusive and are to be repeated, but the inference was that there was an increased production on the larger grain ration, although this might not be profitable where a large production at a minimum cost was the object sought.

So long as the increase in the cost of the ration does not make the cost of producing a unit of milk and butter higher than the unit will bring, it pays to feed grain heavily, but otherwise it does not. With butter at 25 cents a pound, increasing the cost of the ration by 1 or 2 cents by heavy grain feeding is still a good business transaction, while with butter at 14 to 18 cents such method of feeding would be a mistake, and if persisted in, would end in financial ruin.

The New York Cornell Station has recently reported results of experiments in two years which bear directly upon the question of the amount and kind of grain ration. In these experiments medium rations composed of (1) 2 parts of gluten feed, 6 parts of oat chop, 1 part of corn meal, and 1 part of linseed meal, or (2) 2 parts of gluten feed, 2 parts of corn meal, 2 parts of wheat bran, and 1 part of linseed meal, appeared to give better results for continuous feeding than either richer or poorer rations. Taking the experiments of the two years into account the cows on these medium rations (with a nutritive ratio of 1 to 5.7–6) maintained their production of milk and butter fat better than cows on the rations which were richer or less nitrogenous.

Evidently this factor must be taken into account, for it is usually found that cows are stimulated for a short time by being fed a rich grain ration and temporarily produce more or richer milk. It may be mentioned that the experiments at the New York Cornell Station, above referred to, failed to show any permanent effect of the rations on the percentage of fat in the milk.—E. W. ALLEN.

PROTECTING NORTHERN CATTLE AGAINST TEXAS FEVER.

Northern cattle breeders have for many years experienced great losses from Texas fever in shipping blooded stock from the North into Southern States. Northern cattle not being immunized against Texas fever, that is, rendered exempt from it, succumb very readily to the disease, and the losses among cattle shipped from the North have amounted to from 40 to 70 per cent. Any method of rendering Northern cattle exempt from Texas fever (or, as it is termed, immune) is, therefore, of great economic importance to cattle breeders and cattle raisers. The Bureau of Animal Industry of this Department first demonstrated the nature of the blood parasite which causes the disease and the fact of its transmission by means of the cattle tick. It was also shown experimentally by the Bureau of Animal Industry that immunity against Texas fever could be produced in susceptible cattle by inoculation with the blood of native Southern cattle or artificially immunized cattle.

For some time past the Missouri Experiment Station in cooperation with the Texas Experiment Station and the Missouri State Board of Agriculture has conducted experiments for the purpose of perfecting this method, especially in its application to high-bred cattle. The inoculation experiments of the Bureau of Animal Industry were made upon a small number of ordinary cattle. The experiments under discussion were carried out on a large scale and upon a variety of pure breeds of cattle.

It appears that immunity against Texas fever can be brought about only by the production of a mild form of the disease in the animals to be immunized. This inoculation with the disease may be accomplished in two ways: Either by infesting with ticks or by inoculation with blood of immune animals. The latter method seemed to promise better results and has been more thoroughly studied in the experiments referred to.

In the operation fresh blood from an animal which has thoroughly recovered from Texas fever and is perfectly immune should be used. In all cases, however, the inoculated animals develop fever symptoms to a greater or less extent, and some deaths will result from the inoculation fever, but these were less than 8 per cent in the experiments reported. The first fever is to be expected about the eighth or ninth day after the injection of the defibrinated blood and usually persists for somewhat more than a week. The temperature of the animals during this time may be comparatively high and the digestive functions of the animals will be more or less disturbed. Usually a secondary fever period occurs about the twenty-fifth to the thirtieth day after inoculation and continues for a period of about a week. This secondary attack is ordinarily less severe than the first. Occasionally subse-

quent slight attacks of the fever may be manifested, but these are for the most part insignificant. After the animal has thoroughly recovered from the first inoculation, it is frequently necessary to give another inoculation, and after recovery from this second inoculation a third or fourth may be necessary, provided the animals continue to show a fever reaction. It is advisable to use small amounts of blood for inoculation at the start and gradually increase the doses until no fever results. The process of immunizing is a slow and gradual one, and it is probably not safe to consider an animal perfectly immune until about one year after the inoculation.

The animals which are to be immunized should be in good condition and should be well fed and cared for during the experiment. It is especially important to see that the bowels are kept open.

In order to carry out this method of immunizing it is necessary, as already stated, to use the blood in a perfectly fresh condition, and, therefore, to have the animal from which the blood is to be drawn for inoculation purposes on the same premises with the animals which are to be immunized. If the blood for inoculation could be drawn and kept for some time or shipped to other places, it would remove this necessity of having an immune animal at each locality where cattle are to be inoculated. Experiments recently conducted at the Louisiana Station indicate that perfect immunity may be conferred upon susceptible cattle by inoculating them with blood taken from engorged ticks on immune cattle. This discovery may prove of considerable importance since the ticks may serve as convenient receptacles in which to keep the blood for inoculation for a considerable period without danger of its undergoing any changes. The inoculation fever which was produced by using blood from ticks was somewhat milder than that which followed upon inoculation with blood taken from immune cattle, but appeared to confer perfect immunity.—E. V. WILCOX.

EXPLANATION OF TERMS.

TERMS USED IN DISCUSSING FERTILIZERS.

Complete fertilizer is one which contains the three essential fertilizing constituents, i. e., nitrogen, phosphoric acid, and potash.

Nitrogen exists in fertilizers in three distinct forms, viz, as organic matter, as ammonia, and as nitrates. It is the most expensive fertilizing ingredient.

Nitrates furnish the most readily available forms of nitrogen. The most common are nitrate of soda and nitrate of potash (saltpeter).

Nitrification is the process by which the highly available nitrates are formed from the less active nitrogen of organic matter, ammonia, salt, etc. It is due to the action of minute microscopic organisms.

Phosphoric acid, one of the essential fertilizing ingredients, is derived from materials called phosphates. It does not exist alone, but in combination, most commonly as phosphate of lime in the form of bones, rock phosphate, and phosphatic slag. Phosphoric acid occurs in fertilizers in three forms—soluble, reverted, and insoluble phosphoric acid.

Superphosphate.—In natural or untreated phosphates the phosphoric acid is insoluble in water and not readily available to plants. Superphosphate is prepared from these by grinding and treating with sulphuric acid, which makes the phosphoric acid more available to plants. Superphosphates are sometimes called acid phosphates.

Potash, as a constituent of fertilizers, exists in a number of forms, but chiefly as chlorid or muriate and as sulphate. All forms are freely soluble in water and are believed to be nearly, if not quite, equally available, but it has been found that the chlorids may injuriously affect the quality of tobacco, potatoes, and certain other crops. The chief sources of potash are the potash salts from Stassfurt, Germany—kainit, sylvinit, muriate of potash, sulphate of potash, and sulphate of potash and magnesia. Wood ashes and cotton-hull ashes are also sources of potash.

TERMS USED IN DISCUSSING FOODS AND FEEDING STUFFS.

Water is contained in all foods and feeding stuffs. The amount varies from 8 to 15 pounds per 100 pounds of such dry materials as hay, straw, or grain to 80 pounds in silage and 90 pounds in some roots.

Dry matter is the portion remaining after removing or excluding the water.

Ash is what is left when the combustible part of a feeding stuff is burned away. It consists chiefly of lime, magnesia, potash, soda, iron, chlorin, and carbonic, sulphuric, and phosphoric acids, and is used largely in making bones. Part of the ash constituents of the food is stored up in the animal's body; the rest is voided in the urine and manure.

Protein (nitrogenous matter) is the name of a group of substances containing nitrogen. Protein furnishes the materials for the lean flesh, blood, skin, muscles, tendons, nerves, hair, horns, wool, casein of milk, albumen of eggs, etc., and is one of the most important constituents of feeding stuffs.

Albuminoid nitrogen is nitrogen in the form of **albuminoids,** which is the name given to one of the most important groups of substances classed together under the general term protein. The albumen of eggs is a type of albuminoids.

Amid nitrogen is nitrogen in the form of **amids,** one of the groups of substances classed together under the general term protein. Amids, unlike albuminoids, are usually soluble in water, but are generally considered of less value as food than albuminoids.

Carbohydrates.—The nitrogen-free extract and fiber are often classed together under the name of carbohydrates. The carbohydrates form the largest part of all vegetable foods. They are either stored up as fat or burned in the body to produce heat and energy. The most common and important carbohydrates are sugar and starch.

Fiber, sometimes called crude cellulose, is the framework of plants, and is, as a rule, the most indigestible constituent of feeding stuffs. The coarse fodders, such as hay and straw, contain a much larger proportion of fiber than the grains, oil cakes, etc.

Nitrogen-free extract includes starch, sugar, gums, and the like, and forms an important part of all feeding stuffs, but especially of most grains.

Fat, or the materials dissolved from a feeding stuff by ether, is a substance of mixed character, and may include, besides real fats, wax, the green coloring matter of plants, etc. The fat of food is either stored up in the body as fat or burned, to furnish heat and energy.

Nutritive ratio is the ratio of the digestible protein (taken as 1) to the other digestible materials of the food. Thus, if a ration contains one part of protein to every five parts of the other digestible materials the nutritive ratio is 1 to 5.

MISCELLANEOUS TERMS.

Pollen.—The powdery substance, usually yellow or brown, which falls from flowers when they are shaken.

Stamen.—The part of a flower which produces the pollen.

Corolla.—The inner circle or set or leaves (called petals) of a flower, usually bright colored.

Self-fertile plants or varieties are those which do not require pollen from other plants or varieties in order to produce seeds or fruit.

Immune.—Exempt from disease, especially protected by inoculation.

Immunize.—To render immune.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to Senators, Representatives, and Delegates in Congress, or to the Secretary of Agriculture, Washington, D. C.:

16. Leguminous Plants. Pp. 24.
19. Important Insecticides. Pp. 32.
21. Barnyard Manure. Pp. 32.
22. The Feeding of Farm Animals. Pp. 32.
23. Foods: Nutritive Value and Cost. Pp. 32.
24. Hog Cholera and Swine Plague. Pp. 16.
25. Peanuts: Culture and Uses. Pp. 24.
26. Sweet Potatoes: Culture and Uses. Pp. 30.
27. Flax for Seed and Fiber. Pp. 16.
28. Weeds: And How to Kill Them. Pp. 32.
29. Souring and Other Changes in Milk. Pp. 23.
30. Grape Diseases on the Pacific Coast. Pp. 15.
31. Alfalfa, or Lucern. Pp. 24.
32. Silos and Silage. Pp. 32.
33. Peach Growing for Market. Pp. 24.
34. Meats: Composition and Cooking. Pp. 29.
35. Potato Culture. Pp. 24.
36. Cotton Seed and Its Products. Pp. 16.
37. Kafir Corn: Culture and Uses. Pp. 12.
38. Spraying for Fruit Diseases. Pp. 12.
39. Onion Culture. Pp. 31.
40. Farm Drainage. Pp. 24.
41. Fowls: Care and Feeding. Pp. 24.
42. Facts About Milk. Pp. 29.
43. Sewage Disposal on the Farm. Pp. 20.
44. Commercial Fertilizers. Pp. 24.
45. Insects Injurious to Stored Grain. Pp. 24.
46. Irrigation in Humid Climates. Pp. 27.
47. Insects Affecting the Cotton Plant. Pp. 32.
48. The Manuring of Cotton. Pp. 16.
49. Sheep Feeding. Pp. 24.
50. Sorghum as a Forage Crop. Pp. 20.
51. Standard Varieties of Chickens. Pp. 48.
52. The Sugar Beet. Pp. 48.
53. How to Grow Mushrooms. Pp. 20.
54. Some Common Birds. Pp. 40.
55. The Dairy Herd. Pp. 24.
56. Experiment Station Work—I. Pp. 31.
57. Butter Making on the Farm. Pp. 16.
58. The Soy Bean as a Forage Crop. Pp. 24.
59. Bee Keeping. Pp. 32.
60. Methods of Curing Tobacco. Pp. 16.
61. Asparagus Culture. Pp. 40.
62. Marketing Farm Produce. Pp. 28.
63. Care of Milk on the Farm. Pp. 40.
64. Ducks and Geese. Pp. 48.
65. Experiment Station Work—II. Pp. 32.
66. Meadows and Pastures. Pp. 28.
67. Forestry for Farmers. Pp. 48.
68. The Black Rot of the Cabbage. Pp. 22.
69. Experiment Station Work—III. Pp. 32.
70. Insect Enemies of the Grape. Pp. 23.
71. Essentials in Beef Production. Pp. 24.
72. Cattle Ranges of the Soutnwest. Pp. 32.
73. Experiment Station Work—IV. Pp. 32.
74. Milk as Food. Pp. 39.
75. The Grain Smuts. Pp. 20.
76. Tomato Growing. Pp. 30.
77. The Liming of Soils. Pp. 19.
78. Experiment Station Work—V. Pp. 32.
79. Experiment Station Work—VI. Pp. 28.
80. The Peach Twig-borer. Pp. 16.
81. Corn Culture in the South. Pp. 24.
82. The Culture of Tobacco. Pp. 24.
83. Tobacco Soils. Pp. 23.
84. Experiment Station Work—VII. Pp. 32.
85. Fish as Food. Pp. 30.
86. Thirty Poisonous Plants. Pp. 32.
87. Experiment Station Work—VIII. Pp. 32.
88. Alkali Lands. Pp. 23.
89. Cowpeas. Pp. 16.
90. The Manufacture of Sorghum Sirup. Pp. 32.
91. Potato Diseases and Their Treatment. Pp. 12.
92. Experiment Station Work—IX. Pp. 30.
93. Sugar as Food. Pp. 27.
94. The Vegetable Garden. Pp. 24.
95. Good Roads for Farmers. Pp. 47.
96. Raising Sheep for Mutton. Pp. 48.
97. Experiment Station Work—X. Pp. 32.
98. Suggestions to Southern Farmers. Pp. 48.
99. Three Insect Enemies of Shade Trees. Pp. 30.
100. Hog Raising in the South. Pp. 40.
101. Millets. Pp. 28.
102. Southern Forage Plants. Pp. 48.
103. Experiment Station Work—XI. Pp. 32.
104. Notes on Frost. Pp. 24.
105. Experiment Station Work—XII. Pp. 32.
106. Breeds of Dairy Cattle. Pp. 48.
107. Experiment Station Work—XIII. Pp. 32.
108. Saltbushes. Pp. 20.
109. Farmers' Reading Courses. Pp. 20.
110. Rice Culture in the United States. Pp. 28.
111. The Farmer's Interest in Good Seed. Pp. 24.
112. Bread and Bread Making. Pp. 39.
113. The Apple and How to Grow It. Pp. 32.
114. Experiment Station Work—XIV. Pp. 28.
115. Hop Culture in California. Pp. 27.
116. Irrigation in Fruit Growing. Pp. 48.
117. Sheep, Hogs, and Horses in the Northwest. Pp. 28.
118. Grape Growing in the South. Pp. 34.

O